Amendment to the Claims

This listing of claims will replace all prior versions and listings of the claims in the application.

Listing of Claims

1. (Currently Amended) A high temperature solid oxide electrolyte fuel cell generator comprising:

a housing containing a top air manifold feed plenum, an air feed conduit which discharges inlet air into said manifold feed plenum, and associated air feed tubes which connect in a sealed manner to said manifold feed plenum through at least one flexible air feed transport tube, a ~~bottom~~ fuel inlet, a reaction chamber containing fuel cells, and a separate reacted fuel-reacted air combustion chamber above the reaction chamber;

wherein inlet air can be heated internally within the housing in at least one separate interior heat transfer zone located between the separate reacted fuel-reacted air combustion chamber and the air manifold feed plenum, where the separate interior heat transfer zone has the air feed tubes passing therethrough to the fuel cells, where there is an annular space around the air feed tubes within the interior heat transfer zone to pass a combusted exhaust product stream from the reacted fuel-reacted air combustion chamber, said annular space connecting to a separate exhaust chamber above the interior heat transfer zone and below the air manifold feed plenum.

2. (Currently Amended) The fuel cell generator of Claim 1, wherein the air manifold feed plenum is made from low temperature materials useful below 800°C, selected from the group consisting of carbon steel, plastic, and fiberglass, the at least one flexible feed transport tube is made of silicon rubber or an elastomeric material useful below 800°C, where an internal, electrically energized heater is disposed adjacent the reaction chamber, and where the fuel cell generator does not utilize exterior gas feed heat exchangers or pre-heaters.

3. (Canceled)

4. (Currently Amended) A high temperature solid oxide fuel cell generator comprising:

1.) a source of air and a source of fuel;

2.) a top air manifold feed plenum and an air feed conduit which discharges inlet air into said manifold feed plenum, and associated air feed tubes which connect in a sealed manner to said manifold feed plenum through at least one flexible air feed transport tube;

3.) a bottom fuel inlet plenum;

4.) a fuel electrochemical reaction chamber containing fuel cells;

5.) a recirculation chamber directly above the electrochemical reaction chamber in which a fraction of reacted and unreacted fuel are drawn into a recirculation loop;

6.) a separate combustion chamber directly above the recirculation chamber wherein fuel combustion products and reacted air from within the cells combine to complete combustion of the unburned fuel;

7.) at least one separate interior heat exchanger zone, in which the combustion products heat incoming air which is carried in ceramic air feed tubes, where the interior heat transfer zone passes air feed tubes therethrough to the fuel cells, where there is an annular space around the air feed tubes within the interior heat transfer zone to pass a combusted exhaust product stream from the separate combustion chamber, said annular space connecting to a separate exhaust chamber above the interior heat transfer zone; and

8.) a separate combustion products exhaust chamber which lies directly below the top air manifold feed plenum and above the separate interior heat transfer zone.

5. (Currently amended) The fuel cell generator of Claim 4, wherein the air manifold feed plenum is made from low temperature materials useful below 800°C, selected from the group consisting of carbon steel, plastic, and fiberglass, the at least one flexible air feed transport tube is made of silicon

rubber or an elastomeric material useful below 800°C, and where the fuel cell generator does not utilize exterior gas feed heat exchangers or pre-heaters.

6. (Canceled)

7. (Original Claim) The fuel cell generator of Claim 4, wherein at least the fuel electrochemical reaction chamber is surrounded by at least one internal heater panel.

8. (Original Claim) The fuel cell generator of Claim 4, wherein the interior of the ceramic air feed tubes within the interior heat exchanger zone contain at least one of metallic heat conducting inserts and electrically energized heater inserts.

9. (Currently Amended) A high temperature, solid oxide electrolyte fuel cell generator comprising:

1.) a housing defining an air manifold feed plenum containing open tops ends of a plurality of air feed tubes;

2.) a source of air, and an air feed conduit which discharges inlet air into said manifold feed plenum;

3.) a source of fuel;

4.) a pump for pumping the inlet air directly into the air entry manifold feed plenum of the generator through the air feed conduit;

5.) a generator section within the bottom of the housing, containing a plurality of tubular fuel cells, each open at its top end, each having an exterior fuel electrode and an interior air electrode with solid oxide electrolyte therebetween, where the generator section connects to a source of fuel, and the plurality of air feed tubes are inserted within the fuel cells so that the pumped air can contact the air electrodes; and

6.) a separate reacted fuel-reacted air combustion chamber at the top open end of the fuel cells;

wherein the air passing through air feed tubes can be heated internally within the housing in at least one separate interior heat transfer zone, which is disposed between reacted fuel-reacted air combustion chamber and the air manifold feed plenum, where the separate interior heat transfer zone passes

air feed tubes therethrough to the fuel cells, where there is an annular space around the air feed tubes within the interior heat transfer zone to pass a combusted exhaust product stream from the reacted fuel-reacted air combustion chamber, said annular space connecting to a separate exhaust chamber above the separate interior heat transfer zone.

10. (Currently amended) The fuel cell generator of Claim 9, wherein the air manifold feed plenum is made from low temperature materials useful below 800°C, selected from the group consisting of carbon steel, plastic, and fiberglass, the flexible feed transport tubes are made of silicon rubber or an elastomeric material useful below 800°C, and where the fuel cell generator does not utilize exterior gas feed heat exchangers or pre-heaters.

11. (Canceled).

12. (Original Claim) The fuel cell generator of Claim 9, wherein at least the generator section is surrounded by at least one internal heater panel.

13. (Original Claim) The fuel cell generator of Claim 9, wherein the interior of the air feed tubes within the interior of the interior heat transfer zone contain at least one of metallic heat conducting inserts and electrically energized heater inserts.

14. (Currently Amended) The fuel cell generator of Claim 9, wherein a diverter ~~value~~valve is associated with the air pump to pass air into an internal heater and then into the combustion chamber and interior heat transfer zone.

15. (Currently Amended) A method of operating a high temperature solid oxide electrolyte fuel cell generator which reacts feed fuel and feed oxidant at interior fuel cell surfaces comprising:

1.) feeding oxidant into at least one separate interior heat transfer zone within the fuel cell generator through ~~an~~ oxidant feed ~~tube~~tubes, where said zone contains oxidant feed tubes therethrough which pass to fuel cells, and where there is an annular space around the oxidant feed tubes within said zone;

2.) contacting the oxidant feed ~~tube~~tubes within the at least one separate interior heat transfer zone with exhaust spent fuel and spent oxidant products from a separate combustion chamber disposed above the fuel cells and

below the separate interior heat transfer zone, which spent products pass through the annular space around the oxidant feed tubes to a separate exhaust chamber above the interior heat transfer zone; and then

3.) exhausting cooled exhaust from the fuel cell generator, ~~here, the oxidant is not heated before entry into the fuel cell generator~~

16. (Currently Amended) The method of Claim 15~~13~~, wherein before step 1, oxidant is pumped into a top ~~an~~ air manifold feed plenum made from low temperature materials, useful below 800°C.

17. (Currently Amended) The method of Claim 15~~13~~, wherein before step 1, exterior gas feed heat exchangers or pre-heaters are not utilized, the oxidant is at ambient temperature, and where there is a laminar flow within the oxidant feed tubes and within the annular space around the oxidant feed tubes.

18. (New) The fuel cell generator of claim 1, wherein the feed air is ambient air, the air feed tubes, at least within the separate interior heat transfer zone contain interior inserts that collect heat by radiation from the inside wall of the air feed tube and transfer the heat by convection from its interior surface to the air in the air feed tube, and where the separate interior heat transfer zone is ceramic and is a recuperative interior heat exchanger, and said zone constitutes from about 10% to 20% of the length of the fuel cell generator.

19. (New) The fuel cell generator of claim 4, wherein the source air is ambient air, the air feed tubes, at least within the separate interior heat transfer zone contain interior inserts that collect heat by radiation from the inside wall of the air feed tube and transfer the heat by convection from its interior surface to the air in the air feed tube, and where the separate interior heat transfer zone is ceramic and is a recuperative interior heat exchanger, and said zone constitutes from about 10% to 20% of the length of the fuel cell generator.

20. (New) The fuel cell generator of claim 9, wherein the source air is ambient air, the air feed tubes, at least within the separate interior heat transfer zone contain interior inserts that collect heat by radiation from the inside wall of the air feed tube and transfer the heat by convection from its interior surface to the air in the air feed tube, and where the separate interior heat transfer zone is

ceramic, and is a recuperative interior heat exchanger, and said zone constitutes from about 10% to 20% of the length of the fuel cell generator.